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## CHAPTER FOUR

### NONPOINT SOURCE POLLUTION

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Nonpoint source pollution is a general category for pollution which does not emanate from a single location. This pollution is associated with agriculture, silviculture, and urban runoff, as well as leaks from septic tanks and waste disposal sites. It originates from contaminants collected in surface water runoff, discharges from boats and marinas, and atmospheric deposition. Included in nonpoint source pollutants are pathogens, sediments, nutrients, toxicants, and oxygen demanding substances. Most of the pollutants originate on land and are then picked up by rainwater which carries them into streams and rivers that empty into the bay. Because Galveston Bay receives drainage from a large land area as well as discharges from boats and other water based sources, it is difficult to identify the numerous individual sources of pollution.

As point source municipal and industrial pollution is reduced, nonpoint source pollution plays a relatively larger role in the degradation of the nation's waters. 65 percent of the nation's waters fail to meet water quality standards because of non-point source pollution. Similarly, 28 percent of the nation's assessed coastal areas, including lakes and estuaries, fail to meet water quality standards because of urban runoff and storm sewer discharges.

Tables 4-1 through 4-3 provide background information on nonpoint source pollution in the bay area. Table 4-1 illustrates changing land use: as open land declines and the proportion devoted to residential, commercial, and industrial uses increases, NPS becomes more likely and more difficult to control. GBNEP's report on nonpoint source loadings provides two other estimates of land use. Tables 4-2 and 4-3 provide estimates of NPS, the former overall and the latter by land use category. Although Table 4-3 covers only a limited study area (while the others cover the entire 4-county area) it illustrates the differing kinds of NPS pollution associated with different land uses. From a policy standpoint, it would be more useful to normalize these data on a per acre or other appropriate basis. This would highlight which kinds of NPS are most serious for each kind of land use and suggest priority approaches to NPS.

After a brief review of the general regulatory framework for nonpoint source pollution, this chapter considers several causes of nonpoint source pollution in Galveston Bay: agriculture, stormwater runoff, and septic tanks. Soil erosion, another important kind of nonpoint source pollution, is considered in chapter 12. Airborne pollutants that precipitate onto the water, or onto land and then wash into the water, may affect water quality as well. The extent of this problem is unknown, and it is not treated here.

Table 4-3  
Non-Point Source Loads by Land Use  
Average Year in Study Area  
(thousand kg/year except where noted)

Source Load	Urban	Residential	Open	Agricultural	Barren	Wet	Water	Forest	Total
Runoff (x10 <sup>3</sup> ac-ft)	766	371	567	593	21	187	164	345	3014
Total Suspended Solids (millions/kg)	157	46	49	147	57	9	0	17	482
Total Nitrogen	1985	1561	1056	1142	134	192	0	353	6423
Total Phosphorous	350	362	84	264	15	14	0	26	1115
BOD	8000	7000	4000	3000	0	1000	0	3000	26000
Oil and Grease	12000	2000	0	0	0	0	0	0	14000
Fecal Coliforms (x10 <sup>6</sup> cfu)	205	101	17	18	0	4	0	7	352
Dissolved Copper	2.93	1.419	2.167	2.269	0.08	0.716	0	1.318	10.899
Pesticides	0.378	0.183	0.07	0.073	0.003	0	0	0.043	0.75

Source: Groundwater Services, Inc and Rice University. Characterization of Non-Point Sources and Loadings to Galveston Bay. Volume I, Technical Report. October 1991, pp. 5, 12. (We have changed portions of this table that were incorrect in the original document, such as adding up numbers with different metrics.)

## REGULATORY FRAMEWORK

Under the Clean Water Act, pollution sources are divided into two kinds, point and nonpoint. As early as 1972, Congress recognized the difficulty in regulating nonpoint source pollution, noting the absence of technological solutions and the resulting need to rely on land use controls. Congress was, however, unwilling to mandate new local land use controls and agricultural practices standards; instead, they shifted the responsibility for NPS to the states and regional authorities. Governors were to designate areas with "substantial water quality control problems" and then appoint a local agency to develop a plan for managing nonpoint pollution in their regions. Section 208 of the CWA specified that the plans utilize land use controls to reduce nonpoint urban, agricultural, construction, and silvicultural runoff.

Implementation of the law was impeded by the short time allowed for planning, erratic federal funding, inadequate data, and intergovernmental conflicts, reflecting both state agency resentment of the authority of the regional bodies and EPA resentment about its lack of control. The emphasis on land use controls alienated many people, agricultural interests resisted the application of nonpoint controls to farming, and the law itself did not give any level of government adequate authority to control NPS effectively.

A new nonpoint source initiative was included in the Federal Water Quality Act of 1987, which establishes a national policy aimed at controlling nonpoint source pollution. The governor of each state was required to submit two major reports, an assessment report and a management plan, to the EPA Administrator for approval by August 4, 1988. EPA approval of the plans is required before the state can receive federal grants which could cover as much as 60 percent of the implementation costs of the nonpoint source pollution reduction plans. Although \$400 million has been authorized for the federal program from 1988-1991, the \$38.6 million appropriation in FY 1990 marked the first appropriation for the program. An additional \$50 million was appropriated in FY 1991 and \$23 million for 1992.

Section 319 is unusual in that it appears to require states only to consider nonpoint source problems, but not to adopt regulatory controls. However, states are given an incentive to participate in the nonpoint source program by a federal consistency provision in Section 319 which requires states to identify federal financial assistance programs and development programs as consistent or inconsistent with their nonpoint source programs (Anderson, 1990, p. 386-387).

It is possible that Section 319 may follow the fate of Section 208 of the CWA. Section 208 required the development of area-wide waste treatment plans by the states, but no federal implementation money was authorized and few plans developed were ever implemented (Copeland, June 12, 1991, p. 7). Some observers fear that the Section 319 NPS program will be delegated entirely to the states without any federal funding as part of the reauthorization process of the CWA in 1992.

In Texas, the Texas Water Commission (TWC) was responsible for preparing the Section 319 report as the lead agency for surface and groundwater quality in Texas. In 1988, TWC submitted a management program which provided guidance for preventing NPS through the use of Best Management Practices (BMPs) and a document assessing what little was known about NPS in the state. EPA approved the assessment and the groundwater and agricultural sections of the management report; the remaining sections were approved in January 1990. TWC's list of nonpoint source impacted waters includes four parts of Galveston Bay as shown in Table 4-4.

Table 4-4  
TWC's List of Nonpoint Source Impacted Waters

Water body	Length	Pollutant	Source
Houston Ship Channel	32 miles	Fecal coliform DO, metals, nutrients	Urban stormwater runoff
Buffalo Bayou	**	Oil and grease	Stormwater runoff
Clear Creek (above tidal)	44 miles	Fecal coliform DO, chlorides	Septic tanks
Clear Lake	1.7 sq.mi.	Nutrients, fecal coliform	Irrigated crops, septic tanks, stormwater runoff

Source: Texas Water Quality Inventory, Texas Water Commission, 1992.

Early in 1989, TWC established the 27-member Nonpoint Source Advisory Committee to aid in developing and directing the program. It has emphasized public education, distributing publications to educate farmers, ranchers and the general public on the causes and remedies of nonpoint source pollution (GLO Issue Brief publication, 2/28/90).

The 1990 reauthorization of the Coastal Zone Management Act of 1972, other aspects of which are discussed in more detail in other chapters, added management of nonpoint source pollution to the law's goals. States with coastal zone management programs that have received federal approval must develop a Coastal Nonpoint Pollution Control Program. Both the state coastal zone management agency and the designated nonpoint source management agency are responsible for developing and implementing these plans. If the plans meet national standards, the federal coastal management office approves the state plan and provides some funding. Once a state plan is adopted, all federal activities in the affected area must be consistent with the plan.



This brief overview of the laws that take a general approach to nonpoint source pollution reveals the weakness of the statutory framework. States are required to assess the problem but not control it, and federal funding for any aspect of the program is small and declining. In the following sections describing specific sources of NPS, however, we shall see that the major problem does not lie in weak federal or state laws. Instead, the problem is that reduction of NPS requires each individual to alter everyday behavior—something no law can effectively mandate.

## **AGRICULTURE**

Agriculture is a major source of NPS. The Texas Clean Water Council Nonpoint Source Subcommittee believes that agriculture is the single largest contributor to NPS. Pesticides, animal and crop wastes, and soil itself may all run off from farms. Pollutants include sediments, nutrients, organic materials, pesticides, and, in the case of animals, even pathogens. The most common approach to controlling NPS from agriculture is to teach farmers about methods both for minimizing runoff and reducing the contaminants in the runoff and to give them loans or grants to acquire necessary equipment. Cooperative Extension Agents offer more generalized technical assistance, including information on proper use of pesticides.

### **Best Management Practices**

Under the Clean Water Act, concentrated animal feeding operations are considered point sources of pollution and are subject to the National Pollution Discharge Elimination Program (NPDES). Other farm discharges are considered nonpoint sources. The U.S. Soil and Water Conservation Service (SCS) is directed to administer a program to assist farm operators in learning and deploying Best Management Practices (BMPs) for controlling NPS. Many of the federal and related state programs focus on teaching farmers BMPs or providing them with money to implement BMPs.

The SCS is a technical agency within the U.S. Department of Agriculture (USDA) established in 1935 to carry out a continuing program of soil and water conservation of private lands. Through a federal/local partnership with Conservation Districts, SCS provides technical assistance to private individuals, community and watershed groups, and public agencies. The agency studies the characteristics of soil, water, and vegetation and compiles technical guides describing best management practices, and their costs, for controlling runoff and reducing erosion under various types of local conditions. SCS provides on-site technical assistance from conservation specialists to individual farmers to help plan and apply BMPs which will control runoff and erosion. Based on the specific soil and site conditions, Conservation Plans are developed for individual farms. The plans offer suggestions for structural and nonstructural BMPs that will retain precipitation where it falls or move excess water from the land slowly so as to minimize soil loss.

The U.S. Agricultural Stabilization and Conservation Service (ASCS) is also a part of USDA and works closely with SCS. ASCS provides cost-share grants (up to \$3,500 per year) as part of the Agricultural Conservation Program. These grants are provided to individual farms for the installation of BMPs which involve capital improvements such as pollution control facilities, drainage control facilities, and streambank stabilization programs. ASCS conservation programs are administered through local ASCS offices. A farmer-elected Agricultural Stabilization and Conservation committee works with people in the community to assess conservation problems and determine which measures should be offered to landowners in their areas to solve these problems.

Under the Agricultural Conservation Program (ACP) of the ASCS, local committees establish the amount of cost-sharing required for each practice. In the five county area surrounding Galveston Bay, the primary ACP cost-sharing practices used are 1) reorganizing irrigation systems to conserve irrigation water, improve water quality, control erosion, and reduce pollution of water or land from agricultural nonpoint sources, and 2) constructing sediment retention, erosion, or water control structures to reduce erosion and pollution of land or water from agricultural or silvicultural nonpoint sources.

The 1992 ACP allocation for Texas was \$13.2 million, which is distributed among the counties based on a formula that considers conservation needs. The ACP contribution is limited to \$3500 per producer. In the typical cost-share program, 50-75 percent of the cost is paid by the USDA/ASCS. In 1992, Harris County received \$2,558; Galveston, \$2,498; Brazoria, \$8,327; Liberty, \$7,250; and Chambers, \$15,299. The relatively small amounts are explained in part by the flatness of the area, which makes these counties ineligible for other programs involving soil loss. In addition, some counties, including Harris, require extensive permitting to receive grants; farmers are discouraged by the requirements and do not ask for money. Because allocations are determined in part by previous demand, the amount the counties are allocated has decreased. Of the five counties, Chambers has the strongest program, with 10 to 12 farms (out of an estimated 240 farms) participating each year.

Other funding sources for BMP capital investments include the Farmers Home Administration (also in USDA) and the Small Business Administration (SBA). The State of Washington uses its State Revolving Fund to make loans and grants to counties which then make them available to individual farmers for nonpoint source control measures. The Texas Water Development Board could set up a similar program. Finally, a federal program funding conservation ponds for flood control and for watering cattle has had the unexpected side effect of arresting sediment runoff. In Texas, there are 3,000 of these ponds.

The Texas State Soil and Water Conservation Board implements state laws relating to conservation and protection of soil resources, including programs for abating agricultural and silvicultural nonpoint source pollution. It prepared the agricultural and silvicultural components of Texas' NPS assessment and management documents and published 13 fact sheets related to agricultural management for water quality. It has conducted NPS workshops and tours for

the directors of local Soil and Water Conservation Districts, who pass the information on to producers in their districts.

The Texas Soil Conservation Law makes it possible for local landowners to manage their own soil and water conservation districts. Each of the 211 local districts develops a long-range program and plan of work and an annual plan of operations to guide the district in solving its conservation problems. After a landowner signs a cooperative agreement with the district, a conservation plan is developed for the individual farm or ranch. There are now more than 204,000 cooperative agreements in force covering about two-thirds of the agricultural land in Texas.

All state-owned tracts leased for agricultural and grazing purposes must have Soil and Water Conservation Plans. In 1990, approximately 290,000 acres under surface lease had such plans; small and scattered leases surrounded by large private tracts do not have plans because they are not considered manageable units of land. The General Land Office (GLO) requires the lessees in these small tracts to follow minimal guidelines to protect land from erosion and overgrazing. In order to assure that guidelines are followed in these cases, letters of understanding are signed by the lessee and the GLO.

Rules newly proposed by TWC would require concentrated animal feeding operations, an agricultural business where contamination may almost be considered a point source, to ensure that rainfall runoff from open lots is contained. Other proposals include new BMPs to decrease lot runoff volume and wastewater discharges to watercourses.

The several federal and, to a lesser extent, state programs that give farmers assistance in implementing BMPs are small in scope and, at the present rate, will take a decade or more to reach every farmer. The program most likely to be effective is assistance in reducing soil loss, because farmers can clearly see that they save money, saving in fertilizer costs more than they must spend on structural controls. Programs to increase the efficiency of irrigation, in contrast, are not attractive because water doesn't cost the farmers any money, a policy we will again call into question in chapter 7 on freshwater inflow. However, both these programs are much more likely to succeed than those for reducing pesticide use, which may constitute an equally important source of NPS pollution, because no agency yet offers technical assistance for reducing pesticide use analogous to that provided for using BMPs.

## **Pesticides**

The Texas Department of Agriculture (TDA) is the lead agency for pesticide regulation in Texas. TDA may license pesticides for use in Texas independent of EPA's actions; the state also certifies applicators for certain especially potent pesticides. Most pesticides are registered with EPA, which develops a label based on the manufacturer's studies that describes its legal uses. Pesticide labels, often booklets of 50 pages, include the crops and pests for which the product may be used, the timing and concentration of applications, and methods for disposing of

the container. It may also contain special environmental warnings for substances with deleterious effects on bees or in runoff. It is illegal to use a pesticide in a manner not indicated on the label, but enforcement would require an inspector to be nearby every time a farmer used one—an impossible situation. The Texas Department of Agricultural does not maintain data on the amount of pesticides applied in the state.

Under Texas law, farmers must prevent the discharge of waters which have been contaminated by pesticides and shall notify the executive director immediately if such discharge occurs. Unfortunately, most such discharges are a result of runoff after a heavy rain. It is unlikely that farmers have the means to identify, monitor, or even avoid such runoff, regardless of how well informed they are of weather conditions.

The Texas Agricultural Extension Service provides farmers with education and assistance, including information about pesticides. Both state and federal extension agents work closely with farmers to teach them proper pesticide use. However, most agents believe that there is little need to cut down on pesticide applications. It is well known that pesticide manufacturers work closely with extension agents, extolling the virtues of their products in order to get them "prescribed" by the agents, just as pharmaceutical manufacturers provide samples to doctors. Under the present system, therefore, farmers tend to receive personalized technical assistance from people whose mindset favors pesticide use rather than pesticide avoidance. If NPS pesticide runoff is to be controlled through minimizing pesticide use as well as through BMPs, extension agents will have to be trained.

In contrast to the general approach to pesticide use in Texas, the Texas Agricultural Extension Service's Integrated Pest Management program (IPM) has succeeded in lowering pesticide use for certain crops. IPM controls pest populations through measures such as natural enemies, pest resistant plants, cultural manipulations and pesticides. The Extension Service conducts crop-specific educational programs for Integrated Pest Management (IPM). In the Galveston Bay area, attention is focused on rice, sorghum, corn, and cotton. On a statewide basis, the Extension Service reports that it has been especially successful in reducing pesticide use for cotton crops. The IPM program is implemented county by county with an extension office in each county. Each pest management specialist serves a two-county area. Participation in IPM technical assistance programs is voluntary, and farmers must pay for the field service.

The bird and fish kills that used to be associated with routine pesticide applications have declined significantly as EPA and states have used new information to write better labels that take runoff into account and as farmers have become better-informed about the problem. However, NPS from pesticides remains a concern; many very tiny sources still add up in a heavily-affected body of water such as Galveston Bay, and ecological and human health effects of long-term low level exposures to these substances are poorly understood. Most NPS pesticide runoff comes not from deliberately illegal pesticide applications but from sloppy use, failure to understand the complex instructions on the labels, and



severe weather. It will not be an easy task to reduce this source of NPS. More careful benefit-cost studies of pesticide application may show farmers that they should reduce their pesticide use, and additional research on BMPs for pesticide use and runoff minimization may offer means for controlling effects of those applications farmers continue to find beneficial.

### **Evaluation**

The difficulty with controlling agricultural NPS even for the most willing farmers is the complexity of the problem. Different crops must be treated differently, with different BMPs. Soil and topological conditions are unlikely to be uniform, requiring still different methods for minimizing runoff. However, certain kinds of agricultural sites such as rice fields are like large construction sites and can be monitored. Similarly, on dairies and farms with poultry and hogs, the nutrient source is relatively confined and is more readily controlled. Technical assistance and monetary incentives are among the more effective means for controlling agricultural NPS, along with education about reduced use of pesticides. It would be worth investigating whether the Harris County requirements that limit farmers' interest in Agricultural Conservation Program grants could be changed; an effort to increase the counties' participation in all the USDA conservation programs is clearly indicated.

## **STORMWATER RUNOFF**

Because of the high density of impervious areas, including rooftops, streets, or parking lots, urban land uses have a much higher volume of runoff than rural land uses. Even grass lawns are often almost as impervious as some paving. The runoff from these land uses is called stormwater or urban runoff. The pollutants prevalent in developed areas include suspended solids, nutrients, bacteria, oil and grease, and metals and other toxicants. The sources of these contaminants are motor vehicles; applications of fertilizers, pesticides, or herbicides; construction; pet feces; and poor household waste management.

As noted in chapter 4, stormwater discharges are defined as point source discharges under the provisions of the federal Water Quality Act. However, since nonpoint source pollutants are a major constituent of stormwater discharges, the problem is analyzed in this section, which first covers those programs, laws, and regulations that are directed generally towards reducing urban runoff, and then treats briefly the laws and programs related to specific urban sources, including pesticides, construction, motor oil, and waste disposal, including hazardous waste.

### **Controlling Urban Runoff**

**Laws and Regulations.** Storm sewers, ditches, and other surface water conveyance systems were originally exempted from the NPDES program. In 1975, after the Natural Resources Defense Council (NRDC) successfully challenged the exemption in court, EPA revised its regulations to treat stormwater as a point



source because it is discharged from a pipe.<sup>1</sup> Stormwater systems were divided into two categories: industrial discharges and urban runoff discharges. Only industrial stormwater was regulated.

Spurred by EPA's lack of success at formulating a comprehensive storm water regulatory program and the findings of the National Urban Runoff Program that urban runoff posed a threat to the nation's waters, Congress included a stormwater program in the WQA of 1987. It established a new management structure for permitting storm water discharges, imposed new deadlines for the regulatory program, and established a two-stage process for city permits. Part I applications are preliminary: they describe discharges and precipitation, the nature of the receiving waters, and the strengths and weaknesses of both the physical stormwater system and its management and regulatory underpinnings. Part II applications, which outline the specific controls on stormwater to be used in implementing a BMP approach and their costs, will result when approved in a permit valid for five years. Table 4-5 lists the deadlines.

Table 4-5  
Deadlines for Stormwater Runoff Permits

Regulated Entity*	Deadlines	
	Part I	Part II
Municipal >250,000 (with separate storm sewers)	11/18/91	11/16/92
Municipal (100,000-250,000) (with separate storm sewers)	5/18/92	5/17/93
Industrial facilities >250,000 (owned and operated by government)	9/30/91	10/1/92
Industrial facilities (100,000-250,000) (owned and operated by government)	5/18/92	5/17/93
Uncontrolled sanitary landfills, power plants, and airports <100,000 (owned and operated by government)	5/18/92	5/17/93

\*Omits some subtleties regarding individual, group, and general permit for industrial facilities.

Source: *Federal Register*, November 16, 1990; March 21, 1991; November 5, 1991

Permits for municipal systems may be issued on a system or jurisdiction-wide basis, must include a requirement to prevent non-storm sewer discharges into the storm sewers, and must require methods of control which eliminate the

<sup>1</sup> *NRDC v. Train*, 396 F. Supp. 1393.

discharge of pollutants to the maximum extent practicable. Runoff from agriculture, mining, and from oil and gas exploration, production, treatment, or transmission is exempted if the discharge does not come into contact with any raw material, product, byproduct, or waste product located on the site.

In the Galveston Bay area, the City of Houston, Harris County, and the Harris County Flood Control District filed a joint application as municipalities over 250,000 in population. For part two of the application, due in November 1992, Houston conducted a specialized water monitoring to characterize stormwater runoff from at least five kinds of sites: high density (apartments); residential; commercial; industrial; and open space. The plan focuses on pesticide application, household hazardous waste, and erosion from construction sites. A management handbook for construction activities has been issued. Because the cost of implementing the NPS plan will be significant, the city must develop funding mechanisms and, even more important, obtain community support for both its costs and required actions. Finally, planners must determine whether their jurisdictions have sufficient authority to implement the plan or whether action by the City Council or even the Texas Legislature will be required.

Texas law recognized the problem of urban runoff in 1989, requiring cities with populations of 5000 or more to establish nonpoint source pollution control and abatement programs. Under this law, plans must be established and implemented for controlling and abating pollution or potential pollution resulting from generalized discharges of waste which are not traceable to a specific source, such as storm sewer discharges and urban runoff from rain water. TWC reviews the city programs and may adopt rules guiding them. The rules initially proposed were not well received by the cities, and the agency is presently working on revisions which were to be published in summer 1991 but had not yet been published in spring 1992. The rules are now being considered as part of the larger efforts of the Clean Water Council.

Mitigation Programs. TWC's Urban Surface Runoff Program relies on education and technology transfer as the most effective methods for delivering BMPs to the local level. The BMPs for the Urban Surface Runoff Program are contained in the TWC manual "Best Management Practices for the Control of Urban Runoff Water Pollution", which TWC is distributing to cities in Texas with populations over 5,000. TWC is also working with local entities to develop demonstration projects that address urban surface runoff. Among the BMPs to be funded as demonstration projects are extended detention ponds; wet ponds; infiltration trenches; infiltration basins; porous pavement; water quality inlets; vegetative practices; non vegetative practices; and nonstructural controls. TWC's Nonpoint Source Assessment, required by EPA, determined that Lake Houston and the Houston Ship Channel are second priority water bodies which are therefore targeted to receive technical assistance relatively soon.

Other TWC educational and outreach programs include a quarterly newsletter, a video library, radio public service announcements, and citizen's monitoring of the bay. The agency's proposed programs include an advertising campaign which will target individual behaviors contributing to NPS; news media publicity aimed

at providing media coverage to significant NPS events; a community outreach project which will use a public education and awareness campaign conducted by entities at the local level; and a public education grant program directed for public, private and non-profit groups to conduct public education and information projects pertaining to NPS pollution.

As noted in chapter 3, the Texas Water Development Board (TWDB) is responsible for administering federal and state water finance programs, including the State Revolving Loan Funds (SRF) which provides loans for construction, improvement or expansion of sewage treatment and collection facilities and nonpoint source pollution control projects. At the moment, there are no SRF loans which specifically target NPS, although TWDB will entertain funding proposals for nonpoint source projects on the same basis as point source projects.

The Galveston Bay National Estuary Program (GBNEP), in cooperation with the EPA, TDH, GLO, Texas Parks and Wildlife Department, TWC, and the counties of Brazoria, Chambers, Galveston, Harris and Liberty, has developed a handbook that advises on how individuals living in the Galveston Bay area can contribute to the Bay's protection. The handbook addresses four main issues including lawn care, hazardous household products and wastes, automobile care and boat care. A list of contact numbers is also provided in the book.

### **Specific Urban Sources of Nonpoint Source Pollution**

Many different substances may enter the waters of Galveston Bay after being emitted to and carried in the air. Although these air emissions are regulated as point sources by the Texas Air Control Board, they constitute a potential nonpoint source of water pollution. Many organic air emissions are volatile or dissolve, but others include metals that do not dissolve but rather concentrate on the bottom or are ingested by living organisms. The extent of this problem is difficult to measure, although new information about the nature and quantity of air emissions of many toxics is now available under SARA Title III. Because the five-county area contains the largest concentration of air pollution emitters in the nation, it would seem worthwhile to study the nature of these deposits and their effect on water quality.

Industrial sites may also create NPS pollution through runoff. Industry believes this is a trivial problem adequately controlled on-site, and TWC has few resources to monitor these dispersed sources. Only when people complain does the agency investigate or take action.

**Pesticides.** Urban pesticide use is of two types: inside or structural, for control of cockroaches, rats, and other indoor pests, and outdoor. Outdoor uses that may create noticeable nonpoint source pollution arise primarily from lawn applications (fertilizers present the same problem and will not be considered separately), mosquito control, and, sometimes, park management. There is virtually no control of any of these outdoor uses, and the public is generally unaware of any side effects of outdoor pesticide use.

The Structural Pest Control Board (SPCB) is a Texas agency with special authority for urban pesticide use. It develops licensing standards for structural pest control applicators and regulations governing the methods and practices of pest control when adverse effects on human life and the environment are suspected to result. Because SPCB only regulates commercial pesticide applicators for structures, many urban applicators, such as those applying lawn treatments, do not fall under the agency's jurisdiction. On a voluntary basis, the Texas Department of Agriculture certifies private applicators of restricted-use pesticides and other commercial and non commercial applicators who use ornamental and turf pest control or fly control. The Texas Department of Health certifies commercial and non commercial applicators for health-related pest control (i.e. vector, rodent, and sanitation).

Automobile-Related Runoff. In a year with average rainfall, runoff into Galveston Bay contains 31 million pounds of oil and grease (Dawson, p. 18A). People sometimes dump their used motor oil into the storm sewer or out onto the pavement, where it is picked up by the next rainfall. (Many household hazardous materials are disposed of in the same way due to ignorance or the absence of means for disposing of them safely.) Cars deposit oil and grease on streets and sidewalks, again contaminating runoff. The Chesapeake Bay Foundation believes that automobile exhaust carried by the wind and deposited on the surface of the bay also results in measurable contamination. The number of automobiles in the Houston area and the relatively long distances people commute make this a significant source of stormwater pollution.

Under Texas Senate Bill 1340, passed in 1991, service stations and other sites were encouraged to participate as collection centers for motor oil. However, not all stations will take the oil because they are unsure of the content. Even a small amount of anti-freeze can contaminate an entire collection container. When this happens, the service station must pay a high price to the recycler for collecting the waste. The risk is simply not cost-effective. The station can refuse to accept waste other than motor oil, but without an alternative disposal site, the waste either ends up left on the sidewalk, or in the parking lot, or down the storm drain. A more effective approach to automobile fluid recycling will provide safe (and well-publicized) waste disposal for fluids that cannot be recycled. TWC is attempting to develop a program for motor oil recycling in rural areas with widely scattered service stations.

A recent Houston initiative allows curbside recycling of used motor oil from automobiles. Presently, 47,000 homes participate in this program; the city anticipated that 380,000 will be covered within two years.

Construction. Construction sites can be a major source of NPS, especially erosion of soil. The Wisconsin Department of Natural Resources reports that without erosion controls, construction on one acre of land delivers about 30 tons of soil to a stream or lake. Other sources of NPS from construction include oil and grease and hazardous materials, such as paints, if improperly stored, used, or disposed. However, construction sites offer a relatively easy focus for reducing NPS pollution, because they are in effect point sources. Moreover, every locality



requires various permits for construction; NPS mitigation can be made a condition of the permit.

Erosion control consists of two steps. Contractors must first limit the amount of ground disturbed; they must limit the damage caused by changes in water flow on the land. Mechanisms mandated in local ordinances in other states include protecting exposed area with tarps, sod or seeding; keeping rocks and topsoil out of fill material; use of straw bales or silt filter fences to keep soil from moving off site; prohibiting any disturbance of ground within a certain distance of streams or water; downspout extenders, which catch water from impervious surfaces and run it towards appropriate disposal areas such as storm sewers or vegetated areas; and paved or graveled driveways and parking areas to minimize removal of mud and soil from the site on the wheels of construction vehicles. Wisconsin and some other states have developed model ordinances for adoption by localities; some states have mandated that cities adopt these model ordinances.

Waste disposal is another important concern on construction sites. Many contractors simply bury construction debris on the site. Disposal of rubble, rocks, or other noncompacting material destabilizes the site, while disposal of hazardous materials (which is illegal) may imperil ground water or inhabitants. To reduce this problem, cities often require dumpsters to be on a construction site. Some require barrels and containers of chemicals and fuel to be set on plastic. However, monitoring disposal of paint containers and paint-contaminated water is very difficult. Ready availability of sites for leaving household hazardous wastes would reduce the costs to contractors of properly disposing of containers for fuel, paint, cleaners, and other ubiquitous construction site materials.

### **Evaluation**

The new federal stormwater permitting requirements give cities a strong incentive to control urban runoff. Unfortunately, most of the contamination arises from such everyday acts as driving a car and is therefore very difficult to control. For some programs, especially motor oil recycling programs and household hazardous waste collection systems, cities mostly require additional money. Some state programs are available to assist in improving these programs. Money is also available for upgrading stormwater treatment systems; that is, treating the problem rather than its cause. Because of the diffuse and difficult nature of NPS, however, such treatment may be the best mechanism for maintaining the quality of stormwater discharges.

We surveyed directors of wastewater treatment plants in 15 cities in the Galveston Bay area, asking about compliance with the new stormwater regulations. The responses varied from not realizing that there were new regulations to anticipating that compliance would not be a problem. The majority expressed a willingness to comply but were frustrated by a lack of practical solutions for meeting compliance standards. These managers pointed out the difficulties of identifying runoff points and tackling rainwater infiltration problems that lead to sewage overflows and collection system leaks. Other complaints involved a shortage of funds to offset the high cost of monitoring water



quality (most use a biomonitoring system) and upgrading wastewater treatment plants. Very few managers recalled receiving TWDB grants for upgrading their plants. These survey results suggest the need for improved communication between state and city officials as well as some collaborative research into affordable methods (or additional funding) for meeting the new stormwater regulations. Lack of awareness or understanding by relevant city officials will be a major impediment to meeting the stormwater runoff standards and, especially, to trying to get citizens to reduce NPS voluntarily.

Other programs, especially developing strong regulations for construction sites and land uses, will tax political resources as much as financial ones. In this case, the state may be able to help by requiring cities to develop such regulations, accepting the criticism that would otherwise fall on local politicians who might be less able to ensure compliance.

Finally, educating people to adopt habits that limit NPS will be the most difficult task of all. They must learn not to dispose of used motor oil or hazardous liquids down the drain and to limit their use of lawn chemicals and fertilizers. Cities must develop ways of tying these behaviors to costs. We envision an advertisement like this: "Every time you throw a can of used oil down the drain, you raise your taxes 3 cents."

## **SEPTIC TANKS**

There are thousands, perhaps tens of thousands, of septic tanks in the five-county area. Many, especially the older ones and those nearest to Galveston Bay, pose a threat to its water quality. Although leaks from septic tanks frequently affect groundwater, they may also affect surface water in two ways: when the water table is shallow and when systems fail, creating runoff. Poorly designed or failing on-site sewage disposal septic systems can discharge pathogens and household chemicals. Septic tank systems may contaminate groundwater with phosphates, nitrates, pathogens, and organic wastes. Preventing degradation of water quality by septic tanks requires ensuring that they are properly designed, constructed, and maintained.

### **Regulatory Framework**

In the United States, public health has generally been regarded to be a state or local function, in part because only local governments could construct and maintain sewers. Thus the federal government plays a very small role in regulating septic tanks, although the Clean Water Act does require EPA to conduct research into alternative on-site systems and provides some grants to states for pilot projects to demonstrate them. Several agencies, including EPA, the Farmers Home Administration, and the Department of Housing and Urban Development, provide (a decreasing amount of) technical assistance and funding to states and local governments for wastewater management projects. FmHA and HUD require prospective homeowners to certify that a septic system is operating properly before obtaining a housing loan.

The Texas Department of Health (TDH) was the primary authority over septic tanks. After September 1, 1989, TDH either delegated authority to permit and inspect new on-site sewerage disposal systems to counties or exercised this authority in counties without approved waste control orders. On March 1, 1992, the portion of TDH concerned with all aspects of municipal waste, including septic tanks, became a part of the Texas Water Commission. In the following paragraphs, we discuss the regulatory program naming TWC as the state agency but recognizing that most policies have been brought over from TDH and that there has been little time to redefine them. Following that, we consider some problems arising from the merger of the agencies.

On-Site Sewage Facilities (OSSFs) are regulated in three ways: they must be permitted (by TWC or the designated county authority), they must be inspected, and the installers must be trained and licensed. TWC has promulgated standards for construction based on many characteristics, including soil type, volume, topology, and distance from other facilities. OSSFs may have to be lined in order to meet the permit criteria. To obtain a permit, an owner submits a proposed design and a permit fee; the permitting agency may visit the site or approve the permit on the basis of the information provided. Once the OSSF is installed, agency staff inspect it for design and quality of construction. State law provides for fines ranging from \$50 to \$100 for a first offense and \$125 to \$500 for later offenses if an unlicensed person constructs an OSSF or constructing one without a permit. TWC oversees the programs administered by local entities for adequate performance and compliance with state statutes through an annual review.

Enforcement is largely a matter of responding to citizen complaints. OSSF complaints must be investigated within 21 days; complaints received by TWC will be forwarded to the regional offices or authorized agent within 7 days of receipt. The regional office has 30 days to resolve or reasonably attempt to resolve the problem after the regional office is notified of the complaint.

Unfortunately, county officials often impede enforcement. Because the On-Site Wastewater program is a local option program, TWC may monitor and enforce only with local cooperation. This problem is exacerbated by the lack of administrative penalties, making TWC dependent upon local Justices of the Peace, who are generally uninterested in OSSFs, to impose fines. TWC is seeking a means to make enforcement more effective, perhaps through an existing but obscure administrative penalty. In the meantime, to improve relations with local programs, TWC staff would like to hold a series of seminars for the county commissioners explaining the importance of well-constructed and well-maintained septic tanks.

Another problem for TWC is fee collection in the districts. TWC's general policy prevents the agency from collecting fees in the field. Installers who have not been required to pay at the moment they apply for a permit often build the systems without permits. TWC or the county loses the money and an unmonitored system is built.

Merging the Program into the TWC. Costs are always incurred when a program moves from one agency to another. At a minimum, staff time is devoted to moving rather than to program implementation. The move of the TDH Bureau of Solid Waste Management to TWC has been relatively smooth.

At TDH, several staff members worked for the On-Site Wastewater program but were not included in its budget. These staff members were not transferred to TWC, leaving the program short of personnel. The most obvious manifestation of the problem is the inability to conduct inspections, which are quite time-consuming. In the first five months of 1992, the program has conducted 15 out of 193 necessary inspections.

Two other enforcement problems noted above—the inability to collect fees in the field and the lack of administrative penalties—are unexpected consequences of the transition; TDH rules did not create these problems. Statutory or regulatory changes will be needed. Conversely, the transition has also resulted in some important benefits. The On-Site Wastewater employees are now housed in the groundwater section of TWC, allowing for improved coordination between the two programs. Considering that groundwater is frequently contaminated by leaking septic tanks, this new office arrangement is highly desirable. The heightened sensitivity to environmental concerns the staff find at TWC confirms the arguments made by proponents of merging the two agencies and seems to justify the transition.

In addition to the TWC, another agency, the On-Site Wastewater Treatment Research Council, has responsibilities for septic tanks. The Council, which is composed of 11 members appointed by the governor, awards grants for research on wastewater treatment technology. TWC has an opportunity to suggest people for the council, most of whose members are required to have specific skills or backgrounds.

### County Programs

TWC has delegated authority for septic tank programs to all five of the bay-area counties' health departments. Here we briefly review the programs in three of the counties as illustrations of the problems.

Brazoria. The Brazoria County Health Department began issuing permits in June 1985. Six inspectors conduct two inspections for each tank during the construction process: first when the line and tank is set and again after the tank has been finished and the dirt is replaced. Although the county had planned to reinspect the tanks every 3 years, they have neither the time nor the manpower; furthermore, the county commissioners were reluctant to charge for a new permit after a reinspection. No reinspections are performed unless there is a problem reported with the tank. Texas Sea Grant has a multi-agency program which networks with the Brazoria County Health Department, the Texas Agricultural Extension Service, and the Texas Engineering Extension Service to train septic tank installers through one-day topical seminars focusing on pollution problems. Thus far, the program has identified improper installation

and inappropriate site determination (soil type, etc.) as two of the major reasons for septic tank pollution. Thus far seminars have been held on laws and regulations, and on properly choosing an installation site.

Harris. The Harris County Engineer's office has been issuing permits for the unincorporated parts of Harris County since July 1978. The office has issued approximately 12,300 permits in 14 years, mostly during the early 1980s when there was a construction boom in the Houston area. The 16 inspectors check each system once at installation; only spray irrigation systems are reinspected periodically. Other OSSFs are reinspected for a mortgage certification or a reported malfunction. By early 1993, the office expects to begin licensing systems which have undergone major repairs.

Harris County is the only government entity inspecting septic tank systems for the City of Houston and its surroundings. The City of Houston Public Utilities (CHPUD) Department will be working with Harris County officials to implement 1991 state legislation (known as the Bailey Bill) mandating Houston to provide sewer service to anyone within the city boundaries and to newly annexed areas within five years of annexation. CHPUD officials estimate the cost of the program at \$350 million. No state funding is available for implementation. The legislation was spurred by Houston residents who complained that the drainage field for their septic tank systems was not working properly. City officials will implement the new program using an "area by area" approach that targets the worst problem areas first. Officials are still in the process of prioritizing areas for action.

Liberty. The Liberty County Health Department began issuing permits in 1979 and has issued approximately 30 to 50 permits a month over the last 12 years. There are currently two inspectors who perform one inspection before the initial construction is finalized. The inspectors do not perform routine inspections unless there is a problem. The county abides by the rules and regulations of the state with a few exceptions. In Liberty, the office issues a permit regardless of the lot size and requires a sandier back-fill because of the heavy clay in the area

### Evaluation

Ultimately, like other sources of NPS pollution, septic tanks will only cease to be a problem if individuals modify their behavior. Government can take some steps to ensure that septic tank systems are properly designed and installed, and, indeed, TWC needs the ability to assess administrative penalties and to delegate fee collection to district and delegated local offices in order to improve enforcement. However, owners of on-site systems must be aware of their limited working capacity; they must practice water conservation and provide routine maintenance for their systems. They must also recognize symptoms of malfunction before a serious problem arises. The Division of Water Hygiene at TDH has written a pamphlet which informs the public about the importance of proper maintenance of septic systems, how to maintain them, and how the system works. This pamphlet should be distributed and explained to every owner by the person installing the system. Septic tank repair and maintenance crews should also



educate their customers, pointing out that proper maintenance saves money as well as the environment. Finally, cities should try where possible to reduce the number of septic tanks in use; TWDB could use the State Revolving Fund to assist in extending sewer systems to areas where none are presently available.

## EVALUATING NONPOINT SOURCE MANAGEMENT

The essence of nonpoint source pollution is that it is dispersed. Regulation is always cheaper and more effective if regulated entities are readily identifiable and regulated activities are measurable. Thus NPS is by definition tricky to regulate. EPA's mandate that cities must meet stormwater runoff effluent criteria is a means of centralizing an inherently dispersed activity which places the primary burden for regulated NPS itself on cities. We would have liked to understand better the tradeoffs between cleaning the water after collection and limiting NPS at its myriad sources; a study about which means is more cost effective would be extremely useful in developing sensible policies.

Meanwhile, except for modifying construction permits, the only means apparently available for reducing NPS is public education. Unfortunately, the public may not be very responsive to education: in a recent survey (conducted by a commercial firm for the U.S. Department of the Interior and the Advertising Council), even people who believe that solid waste disposal or air quality are national problems don't think they are problems in their own communities; natural areas, public areas upkeep, and water quality aren't regarded as serious problems at all. If they aren't problems, why do something about them? More important, people don't think they bear the responsibility for correcting environmental problems; on a scale in which 10 represented strong responsibility for correcting an environmental problem and 1 low responsibility, government was ranked 6.9, industry 5.8, consumers 5.2, and citizens 4.9 (reported in *Chemecology*, November 1991). No matter the specifics, the message that people don't care to take personal responsibility for the environment is clear.

One way to overcome this problem is to build economic incentives into everyday transactions. Bottles disappear from roadsides when they carry a 5- or 10-cent returnable charge. Automobile batteries are treated similarly in some states. Why not used motor oil or paint cans? It will take some creativity to figure out how to reduce urban (and agricultural) pesticide use and minimize soil erosion and runoff using such incentive methods, but it probably can be done. Indeed, nonregulatory means for achieving environmental goals are at long last receiving renewed and much merited attention. For reducing NPS, which requires lifestyle changes that are notoriously difficult to accomplish, such economic incentives are probably the only answer.



## SUMMARY EVALUATION: NONPOINT SOURCE

1. Problem. Dispersed pollution from everyday activities gets into stormwater through runoff, reducing water quality. This is a growing problem, especially as point sources are brought under control. 65 percent of national waters fail to meet water quality standards because of non-point source pollution. Similarly, 28 percent of the nation's assessed lakes, estuaries and coastal areas fail to meet water quality standards because of urban runoff and storm sewer discharges.

2. Authority. The Federal Clean Water Act requires cities to treat stormwater runoff before discharging as a point source. States must develop NPS plans. TWC requires cities to develop plans. Little authority over specific activities generating NPS: localities permit septic tanks properly constructed; urban pesticide use unregulated; agricultural land use (soil erosion) and pesticide use largely unregulated; construction sites permitted for other purposes by localities. Best management practices (BMPs) have been developed for cities treating stormwater, for farmers, and for other entities to help them control runoff.

3. Capacity. Low, because reducing NPS requires working with thousands of individuals. TWC has a NPS program.

4. Policy. Incentives and technical assistance to farmers to improve practices through agricultural agencies. TWC committed to reduction within available authority. Localities generally not yet coming to terms with their responsibilities.

5. Technical and environmental results. Extent of problem not clearly defined. No baseline data for measuring improvement or worsening, although presumably NPS rises with increase in impervious cover within watersheds.

6. Barriers and problems.

Multiple agencies and governments, each focusing only on one aspect (such as agricultural erosion).

Complexity of problem: different crops and soil types have different best management practices.

Dispersed nature of the problem. Difficulty of getting people to change individual behavior.

7. Recommendations.

a. Encourage city use of SRF for NPS reduction—presently allowed but unused. Allow use of SRF at TWDB to make NPS loans to counties for further loan to individual farmers, other entities.

b. Develop means for using the market to encourage individuals to reduce NPS analogous to refundable deposits on bottles and auto batteries.

c. Develop ad campaigns based on cost: "Every time you dump used oil into the storm sewer, your taxes rise 3 cents." "Every time it rains, you lose one ton of topsoil, which has to be replaced by \$500 worth of fertilizer."

d. Legislature should require cities and counties to include runoff controls and waste disposal restrictions in construction permits.

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